In the Matter of	)	
	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
	)	
	)	
	)	
High-Cost Universal Service Support	)	
	)	WC Docket No. 05-337
	)	

COMMENTS OF THE NEBRASKA PUBLIC SERVICE COMMISSION

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I. INTRODUCTION

The Nebraska Public Service Commission (NPSC) appreciates the opportunity to comment on the issues raised in the Commission's Notice of Proposed Rulemaking[1] in response to *Qwest Corp v. FCC*, 398 F.3d 1222 (10th Cir. 2005) ("*Qwest II*"). The Commission seeks comment on a number of issues including how it should define the statutory terms "sufficient" and "reasonably comparable", how it should modify the high-cost support mechanism for non-rural carriers, and whether the Commission should adopt a non-rural insular mechanism. In response to the Commission's request for comment, the NPSC submits that compliance with the Tenth Circuit Court of Appeals (Tenth Circuit) requires careful balance and consideration of the seven principles outlined in section 254 of the Telecommunications Act of 1996 (the Act), and a mechanism which advances universal service reducing the rate disparity between rural and non-rural areas. The best way to accomplish this task, the NPSC believes is to make use of the federal-state partnership the Act envisions. While, in this proceeding, the Commission is only seeking comment regarding the determination of support for non-rural carriers, the NPSC submits that a single model should be adopted that would apply to both rural and non-rural carriers. The purpose of universal service funding should be to support high-cost areas irrespective of the company that serves those areas. A properly developed universal service mechanism will identify where support is needed most and target support to meet those needs. To the extent quantifiable differences

[1] *In the Matter of Federal-State Joint Board on Universal Service High-Cost Universal Service Support*, Notice of Proposed Rulemaking, CC Docket No. 96-45, WC Docket No. 05-337 (December 9, 2005)(*NPRM*).

between classes of carriers can be identified, the model described below can modified to account for those differences. The NPSC submits the following comments and proposals which accomplish the goals established by Congress and the requirements of *Qwest II*.

II. RECOMMENDED MODEL

Most significantly, universal service support should be targeted to the high-cost areas of the country where support is most needed. The appropriate mechanism will properly identify and target support in such a manner. States can play an important role in directing universal service support to rural and high-cost areas within a state.

In the *NPRM*, the Commission sought comment generally regarding whether there are any universal support mechanisms that would address the Tenth Circuit's concerns.[2] The Commission asked commenters to describe any proposed plan in detail and explain how the proposal would better address the Act's goals.[3] The proposed support methodology described below is designed to determine universal service funding needs within a state based on embedded costs associated with high-cost areas. The methodology is detailed in large part as it relates to the cost of connecting subscribers to the network or local loop. The NPSC uses the term local loop generally to describe the facilities used to connect subscribers to the network regardless of whether that is accomplished through wireline or wireless technologies. However, similar procedures can be

[2] *See NPRM* para. 28.
[3] *Id.*

employed, as explained below, to provide support in high-cost areas for other network elements, including switching and transport.

A. Local Loop

Universal service support of the local loop is necessary to continue to ensure quality services, provided at just, reasonable, and affordable rates, reasonably comparable, in all regions of the nation. This universal service support amount can be estimated using a 14-step procedure. The procedure itself is broken into two phases. In Phase One, which contains the first eight steps, a representative sample of study areas is used to determine a functional relationship between embedded per-line loop cost and cost features relevant to any particular area. In Phase Two, which contains steps nine through 14, this relationship is used to estimate embedded loop costs and the resulting universal service needs throughout a state.

1. Phase One

Phase One begins by disaggregating embedded costs between high-cost and low-cost sub-areas of a study area. Sub-area results are then converted into a per-line embedded cost. The per-line embedded cost is modeled as depending upon sub-area demographic, geographic, scope, and scale features. Regression analysis is used to predict per-line cost as a function of these features.

Embedded costs are typically reported at a low level of granularity, e.g. study area, making it difficult to separate embedded costs between high-cost and low cost sub-areas within one study area. In contrast, forward looking cost models used in the FCC's universal service docket produce results at a high level of granularity.[4] Using these forward looking cost models, it is possible to estimate the distribution of costs between high-cost and low cost sub-areas within one study area. The relative distribution of costs on a forward looking basis is assumed to hold on an embedded cost basis. For example, if 40 percent of a study area's forward looking costs are in high-cost sub-areas, then 40 percent of its embedded costs are assumed to be in high-cost sub-areas as well.

Embedded costs are themselves hypothesized to be functions of measurable sub-area demographic, geographic, scope, and scale features. Regression analysis is used to quantify the relationship between embedded cost and the underlying sub-area features. The resulting coefficients are used to estimate embedded costs in any area as a function of its measurable features.

Phase One is divided into eight steps. The steps are shown in Table 1 and then described in detail following the table.

Table 1
Phase One in Predicting Embedded Loop Costs
in High-cost and Low Cost Sections of a Study Area

STEP	DESCRIPTION
1	Select a Forward Looking Cost Model
2	Choose a representative sample of study areas
3	Estimate forward looking cost for each sub-area of a study area
4	Determine percentage of forward looking cost in each sub-area
5	Estimate sub-area embedded cost based on percentage of forward looking cost
6	Reduce to per line basis
7	Measure features of cost for each sub-area
8	Regress sub-area per-line embedded cost on features

[4] *See Federal-State Joint Board on Universal Service*, Report & Order, 12 FCC Rcd 8776 (1997)(Universal Service Order); *see, also, In the Matter of the Nebraska Public Service Commission, on its own motion, to investigate cost studies to establish Qwest Corporation's rates for interconnection, unbundled network elements, transport and termination, and resale* Application No. C-1633, Order (May 22, 1998). These models include the BCPM, HCPM and HAI.

Step 1: Select a Forward Looking Cost Model

The fundamental idea for developing aggregate embedded loop cost is that the relative distribution of embedded loop costs between high and low-cost sub-areas within a study area is the same as the relative distribution of forward looking costs. A forward looking cost model is necessary because it reports costs and other disaggregated information for sub-areas within a study area. For example, the Benchmark Cost Proxy Model (BCPM) divides a study area into smaller units of analysis called ultimate grids. The model produces a variety of data, including costs, lines, density and other information for each grid. This information can be used to measure a study area's relative allocation of costs among grids.

Step 2: Choose a Representative Sample

The fundamental embedded cost estimation process uses regression results from a control sample of study areas to estimate embedded costs for sub-areas on a statewide and nationwide basis. Therefore, it is important to select a representative sample of study areas to use in developing regression results. For example, in developing its state universal service fund, Nebraska utilized a representative sample of both rural and urban study areas.[5]

Three issues need to be considered when selecting the sample to be used in estimating loop cost as a function of underlying features. The first issue is sample size. Sample size determines the reliability of the predictions. The

[5] *See In the Matter of the Nebraska Public Service Commission, on its own motion, seeking ot establish a long-term universal service funding mechanism,* Application No. NUSF-26, Findings and Conclusions (November 3, 2004) at Appendix A, p. 2 (*NUSF-26*).

appropriate size will depend on loop cost variance, the confidence interval desired and the tolerance for size of error in the prediction. The variance can be determined from the chosen sample. A typical confidence interval is 95 percent. The tolerance for error will depend on the mean and variance of the estimated loop cost. Formulas are available to determine the appropriate sample size based on these factors.

The second issue to consider when selecting the sample is proportional representation. The idea behind proportional representation is that the sample should reflect the same relative makeup of the population. For example, if a certain percentage of areas used to calculate universal service needs nationally have relatively low population densities, then the same proportion in the sample should have relatively low population densities. A reasonable way to approach this issue is to divide areas into population density quintiles. Then, the percent of areas in each quintile should be the same in the sample as it is in the population. There may be other characteristics upon which proportional representation may matter. These might include large versus small companies and geographic terrain.

The third issue to consider is randomization. Once the relative shares within each quintile are determined, the particular areas selected should be random. For example, if there are 1,000 areas in the second quintile and only 200 are needed; those 200 should be randomly chosen from the 1,000.

Step 3: Estimate Forward Looking Cost for each Sub-Area

The forward looking cost model is used to estimate cost in each study area from the sample, as well as the component sub-areas within each study area. Again, Nebraska utilized the BCPM model to estimate costs in the study areas and in each sub-area or ultimate grid. The grid data were then aggregated into nine density zones per study area.[6] The aggregated data were used to determine forward looking cost within each density zone.

Step 4: Determine Percentage of Forward Looking Cost in each Sub-area

The sub-area costs can be compared to determine the relative distribution of forward looking costs across the study area. Nebraska's results, for example, indicate that over fifty-five percent (55%) of statewide loop costs were in the least dense zone, while less than two percent (2%) were in the densest zone.

Step 5: *Estimate Sub-Area Embedded Cost Based on Percentage of Forward Looking Cost*

Sub-area forward looking cost allocations are applied against study area embedded cost to determine the amount of embedded cost assigned to each sub-area. For example, if an entire study area's embedded cost is $1 million, and twenty percent (20%) of forward looking cost is in the least dense sub-area, the embedded cost associated with that sub-area is twenty percent (20%) percent of $1 million, or $200,000.

[6] *See id.*

Step 6: Reduce to Per Line Basis

The methodology determines universal service funding needs based on a comparison of cost to a revenue benchmark on a per-line basis. Consequently, it is necessary to transform sub-area total embedded cost into sub-area embedded cost on a per-line basis.

The conversion, in general, is straightforward; embedded cost divided by total number of lines. Although it must be noted, to facilitate this conversion, high capacity services, e.g. DS-N and OC-N, must, in some manner, be converted to a common unit level, DS-0. However, while the areas in which these types of circuits pervade tend to be denser, the issue is of little consequence as per-line cost in these areas will undoubtedly be below the revenue benchmark. In Nebraska, for example, virtually no area with a density greater than 18 household per square mile received state universal service support.

Step 7: Measure Features of Cost for each Sub-Area

The next step in this phase is to relate cost to sub-area demographic, geographic, scope, and scale features. To do this, a model is developed that explains per-line embedded cost as a function of these features. Measuring these features for each of the sub-areas in the representative sample of study areas is step seven. Features may include population density, sub-area square miles, average loop length and geographic variables such as terrain and soil type. The data will have to be developed from a variety of sources including Census data.

Step 8: Regress Sub-Area Per-Line Embedded Cost on Features

Once per-line embedded cost is estimated and cost features are developed, the final step is to regress cost on the features to estimate regression coefficients. A functional form can be used to reflect any potential non-linearities evident in the data. The important outcome of this step is the estimation of coefficients that can be used to predict embedded loop cost as a function of the underlying determinants.

2. Phase Two

In Phase Two, Census boundaries are used to develop likely high-cost and low-cost areas throughout the country. Measurable demographic, geographic, scope, and scale features are developed for each Census-based area and the previously described regression coefficients are used to predict per-line embedded cost in each area as a function of those features. Cost is then compared to a benchmark and aggregated to the state level to determine statewide loop universal service needs. Again, similar procedures can be employed to determine support for other elements.

Phase Two contains steps nine through 14 in the process. The steps are shown in Table 2 and then described in detail following the table.

Table 2
Phase Two in Predicting Embedded Loop Costs in High-cost and Low Cost Sections of a Study Area

STEP	DESCRIPTION
9	Develop Census areas
10	Measure determinants of cost for each Census area

11	Predict embedded cost as a function of regression results and measured cost determinants for Census area
12	Develop cost benchmark
13	Calculate support in each sub-area
14	Aggregate costs to the state level

Step 9: Develop Census Areas

Study areas within each state are divided into town and non-town sub-areas. Each town is made up of its member Census blocks with densities greater than some number of households per square mile. Nebraska identified town sub-areas as cities, villages or unincorporated areas with 20 or more households and densities greater than 42 households per square mile. Out of town areas are defined as those that remain.[7] The town and non-town sub-areas reflect cost causation and prevent any arbitrage that may occur if high- and low-cost loops are combined into one support area.

Step 10: Measure Cost Features for each Census Area

Once the town and non-town sub-areas are determined, Census and other data can be used to develop the cost features in each sub-area. The Census should provide square miles and density. Other sources may provide distance and terrain features.

Step 11: Predict Embedded Cost as a Function of Regression Results and Measured Cost Features for Census Area

The coefficient estimates from Step 8 are combined with the cost features measures in Step 10 to predict the embedded cost per-line in each sub-area, or expected embedded cost.

[7] *See NUSF-26* Appendix A, p. 6.

Step 12: Develop Cost Benchmark

In Step 12, an affordability benchmark is developed for use in the determination of sub-area support, developed in Step 13. The affordability benchmark represents a just, reasonable and affordable rate that ensures consumers in rural and high-cost areas have access to telecommunications and information services at rates reasonably comparable to those charged for similar services in urban areas.

In response to the Tenth Circuit's concern that an affordability benchmark developed in this way does not connect cost to rates actually paid by the consumer, the NPSC proposes the Commission adopt tests to compare actual rates and revenues to the affordability rates and revenues. This methodology would pair rates to costs in the reasonably comparable context.[8]

The NPSC urges the Commission to develop such an affordability benchmark that encompasses all services utilizing the network; local, long distance, VoIP, xDSL, etc.

The affordability benchmark should account for those services, purchased by the average customer, which utilize the network. Thus, universal service need becomes a function of affordability and the network, rather than a particular service.

The Commission should structure the affordability benchmark in a manner that will create a link between the cost of providing the services offered to the

[8] *Qwest II*, 398 F.3d at 1237.

rates charged to consumers as required by the Tenth Circuit. The NPSC agrees with the Commission's suggestion that it is more appropriate to ground the amount of support on the principle of affordability rather than just sufficiency. [9] The NPSC submits that the goal of affordability should be the most significant principle considered when structuring the universal service mechanism. Sufficiency of the fund can be determined after an affordability benchmark has been determined. The level of the fund can be adjusted where reasonable to meet the affordability tests established and to promote a network that will be able to bring basic and advanced services in the underserved areas.

We do not believe that an income standard should be adopted as part of the high-cost mechanism. The only correct way in which to implement an income standard would be a method which assesses income at a household level. While this is possible for the Lifeline/Link-Up program, such an undertaking on a national basis would be impossible. There are more than 600,000 households in Nebraska and means testing each would be a monumental task. In all likelihood the costs would greatly exceed the benefits. Additionally, averaging income across a state or other geographic area would not result in affordable service for everyone and would not comply with the express intent of the Act. There are very rural counties in Nebraska, in which the majority of the population have incomes below the national average, while celebrities own adjacent ranch land. This significantly skews the average income in that county. Further, how would the income benchmark be determined? Nearly every one of the programs used for the Lifeline/Link-Up program uses a different method to determine income.

[9] *See NPRM* at para. 11.

The best way to advance universal service is to adopt the concept of supporting networks rather than services and to require that these networks over time are capable of supporting advanced services as discussed in these comments.

Step 13: Calculate Sub-Area Support

In sub-areas where the predicted loop cost is greater than the revenue benchmark, the difference is multiplied by the number of lines in the sub-area to determine required support. In sub-areas where the predicted loop cost is lower than the revenue benchmark, no support is needed.

Step 14: Aggregate Costs to the State Level

Finally, sub-area support needs are aggregated across all sub-areas within a study area and all study areas within a state to determine the respective state's universal service need.

B. Transport

The process for determining transport costs is very similar to the process for determining loop costs. The fundamental steps are the same as those listed in Tables 1 and 2. Some of the details will vary. In Step 7, for example, the determinants may differ from those utilized in the determination of loop costs.

C. Switching

The process of estimating switching costs will be somewhat different than the processes used to estimate embedded loop or transport costs. Study area embedded switching costs can essentially be allocated to each sub-area, based on the relative number of sub-area lines.

III. TARGET AND IDENTIFY WHERE SUPPORT IS NEEDED

The main objective of the steps outlined above is to identify where support is needed and target support accordingly. A highly targeted universal service mechanism is a critical component to accomplishing universal service goals and the requirements of Section 254. The Commission can utilize such a mechanism to ensure that rates are reasonably comparable, that services are affordable.

A. Single Network

The Commission should adopt a mechanism which promotes strong infrastructure development. The universal service mechanism should be competitively and technologically neutral. That is, the mechanism should not be used to artificially create competition where competition would not naturally develop and to the extent possible, the mechanism should not interfere with the development of competition. Rather, the universal service mechanism should be used to bring affordable and new services to rural insular areas. In order to ensure that the funds are used in an efficient manner, the NPSC recommends that the Commission develop a mechanism which supports a single type of network in each study area. The NPSC adopted a mechanism which supports a single type of network after considering the staff proposal which is attached as Appendix "A" and fully incorporated herein. [10]

[10] While the attached appendix contains state specific analysis of formulaic representations of the Nebraska universal service support determination process, the NPSC believes the theory to be sound and generally applicable.

1. Support should be targeted to the network and not the service.

Universal service support should be targeted to strengthen the network capabilities and should not be tied to the type of service offered. However, all services offered on the network should be taken into consideration. While the model described herein focuses on support for a wireline network, the same general principal can be applied to a wireless network. The NPSC would suggest that support for a wireless network should be funded from a separate program. The NPSC views wireless service as more of a complimentary service and therefore does not believe support of a wireline and wireless network through separate programs to be supporting more than a single type of network. Both the wireline and wireless programs as well as the Low-Income, Schools & Libraries, and Rural Tele-Health programs should be funded from a single surcharge but then administered as separate programs. This does not imply that households can receive support for more than a single line because federal universal service support should no longer be used to support service but rather networks. Support of both networks would ensure that consumers would be able to choose either technology for provision of their telecommunication services. Administering the programs separately reflects the real differences in cost drivers between the two technologies. For example, density is the most significant cost driver for both wireline and wireless network, but the density with a given geographic area can be very different between the two networks.

2. Balance of Interests

In areas where universal service need exists, policies that foster competition often result in adverse impacts to universal service. Specifically, a policy which supports multiple networks within a given support area, is outside of the public interest, foreshadows adverse impacts on customers, and is not economically justified.

A utility firm generally experiences relatively greater fixed costs than firms in other industries, as it is typically unusually capital intensive.[11] Thus, in the telecommunications industry, fixed costs tend to make up a larger portion of total cost than in most other industries where retail revenues often contribute to fixed cost recovery, while universal service support is applied to fixed cost recovery in its entirety.

Consequently, as retail revenues often contribute to fixed cost, a decrease in market share results in a decrease in total revenue[12] and a decrease in fixed cost recovery. The affects of said market share loss can be most devastating in sparsely populated high-cost areas.

Economic theory dictates that a provider that does not recover its fixed cost, in the long run, has three alternatives; increase rates, increase the amount of support received, or exit the market, none of which are beneficial to consumers.

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[11] Alfred E. Kahn, *The Economics of Regulation Principles and Institutions* (Cambridge, M.A.: The MIT Press, 1988), 35-36.

[12] $$TR_i = USF_i + BM_i(q_i) \qquad (1)$$

The results of taking the partial derivative of Equation (1), with respect to q, is listed below.

$$\frac{\partial TR_i}{\partial q_i} = \frac{\partial}{\partial q_i}\left(USF_i\right) + BM_i > 0 \text{, where } \frac{\partial}{\partial q_i}\left(USF_i\right) \geq 0 \text{, for every i.} \qquad (2)$$

In a universal service environment with limited financial resources, support of multiple networks may have significant negative impacts to customers and universal service, making it unsustainable.

Technologically neutrality issues can be address by allowing any applicant to petition the Commission to designate it as the supported network provider in lieu of the current designated provider in a study area.

B. The NPSC's State Universal Service Fund Allocation Mechanism.

The NPSC adopted a state universal service funding mechanism which supports a single network.[13] In its findings and conclusions, the NPSC created a threshold determination that it would only support a single network in each support area. State universal service support is highly targeted based relatively on household density. Any carrier can petition the NPSC to be the supported carrier in a given area. The petitioning carrier is required to demonstrate that it is able to serve the entire area, that it can provide the supported services and that it would honor all interconnection agreements so that other competitors who also use the network are not harmed by the entry of a supported competitor. In the alternative, a petitioning carrier may demonstrate to the NPSC why it would serve the public interest for the state universal service fund to support two networks in a given area.

IV. COST MEASURE AND MODEL

Two prominent measures of cost exist, forward-looking and embedded. The methodology presented here determines a functional relationship between embedded loop cost per line and cost characteristics relevant to any particular

[13] *See generally NUSF-26.*

area using a forward-looking cost model to estimate the distribution of embedded cost between high-cost and low cost sub-areas.

A. Cost Measure

Embedded cost, generally used in rate of return regulation, is a backward looking, historical, measure of cost based on the accounting records of the utility, practical for evaluating historical financial performance. The methodology presented here utilizes embedded cost as the measure to determine universal service support need.

However, embedded cost is generally difficult to track to the level of granularity necessary to produce a method that adequately and appropriately directs and focuses universal service support to rural, insular, and high-cost areas. Thus, a forward looking cost model is utilized to estimate its distribution.

Generally, the use of embedded cost in a multiple carrier environment is seen as inefficient, as embedded cost will tend to either over or under estimate a competitor's cost.[14] However, as the NPSC is recommending support be provided to a single network,[15] the use of embedded cost is acceptable.

B. Cost Model

Forward looking, or economic cost, is a theoretical measure of cost, based on the theories and practices of economics and the industry. Economic cost is forward looking in nature and useful in analyzing the complex issues and variables in a competitive environment. The methodology presented here utilizes a forward-looking cost model to estimate the distribution of embedded costs

[14] Ultimately, embedded cost could be removed from the process in its entirety and forward-looking cost utilized as a surrogate, eliminated the need to estimate embedded cost in sub-areas.
[15] *See supra* at 14.

between high-cost and low cost sub-areas. Either a forward-looking or embedded cost model could be utilized as the vehicle with which to estimate sub-area embedded cost. Nebraska adopted a similar proposal using a forward-looking cost model.[16]

V. FEDERAL AND STATE UNIVERSAL SERVICE FUND APPORTIONMENT OF SUPPORT

Clearly, the Act envisions a partnership between the Commission and the states on universal service and a sharing of the burden. As part of its requirement to ensure comparable service, it is incumbent upon the FCC to ensure that the universal service burden for any state is not too great, as it would translate into a significantly larger burden for service users within such a State. The methodology described in these comments seeks to quantify the entirety of the universal service funding obligation and then apportion the support obligation between the Federal and state jurisdictions in a manner that ensures that the funding burden of the state does not result in rates that are not comparable.

This apportionment occurs in two steps which are referred to as Tier 1 and Tier 2 support. Tier 1 support is split 50-50 between the Commission and the states up to a cap. This cap could be calculated in many ways, including an amount per access line, per household, per person, or based upon revenues with a state. If the support generated under Tier 1 does not meet the entire funding

[16] *See* Frost, Tyler E. and Rosenbaum, David I. 2005. "Recommendations for a Permanent Universal Service Support Mechanism." *Journal of Applied Regulation* Vol. 3, December 2005. pp. 31-44.

needs then that state would receive the difference in the form of Tier 2 support which would be funded entirely from the federal USF program.

Nothing in this apportionment should dictate the manner in which a state could generate its USF funding. For example, if access lines are used in the Tier 1 apportionment, a state could still use a revenues based or any other methodology permitted under the Act to fund universal services. While the described methodology would create strong incentives for states to create their own universal service programs through the explicit allocation of a funding requirement, it would not require a state to create a universal service program. Rather this method is simply a quantifiable and impartial method to allocate the universal service obligation between the federal and state jurisdictions in a manner that allows the Commission to meet its statutory requirements.

Tier two support is designed to supplement Tier one support in the event that Tier one does not fully capture the support needed. Tier two would only be available if the support area is inside a state that has an intrastate mechanism providing funding in Tier one. The Commission would thereby incent states to supplement the federal fund.

VI. CHECKS AND BALANCES

There should be meaningful and quantifiable tests to verify that calculated funds are needed and being properly used by the Company. A state role with federal parameters would help ensure that federal goals/objectives are met. state commissions are best situated to perform these tests. In the event a state commission is precluded from or unable to perform these tests, they could be performed by the FCC instead. There are three types of tests the Commission should consider adopting.

First, a comparison of benchmark rates/revenues to actual rates/revenues should be performed in order to determine need and to reflect that not all commissions have authority over any or all rates. If rates/revenues exceed the applicable benchmark then a company's support should be reduced by the difference. No additional support should be made available if rates/revenues are below the benchmark.

The second test would function as an investment incentive test and should consist of an analysis of actual network investments in rural and high-costs areas. The total level of such investments could be compared to the benchmarks investments produced by the universal service funding model. Companies whose investments levels are well below those used to determine their universal service support should receive reduced universal service support.

The third test should measure the deployment of advanced/broadband services in rural areas by recipients of federal universal service support based on criteria set forth by the Commission. This could consist simply of meeting broadband deployment percentage in rural/high-cost areas. Companies that do not meet defined deployment benchmarks should also receive reduced universal service support.

Any unused federal universal service support should be returned to the federal universal service fund program.

VII. CONCLUSION

The Commission should consider proposals that identify and target support to where it is needed. Universal support should be directed to maintaining improving the network rather than particular services. A quantifiable test should be used to measure not just where support is needed but also how it is being used by the carriers. The NPSC's recommended model can be used to correctly identify and target support in an appropriate manner, is designed to improve the network used by the carriers to deliver the desired services, and has quantifiable checks and balances to verify support is being used to deliver quality services in a manner that is affordable to consumers and at rates that are reasonably comparable. The model recommended herein accomplishes all of the requirements of the Act, and accordingly should be adopted.

Respectfully Submitted,

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Implications of Supporting Multiple Networks in a Universal Service Environment

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ABSTRACT

As state commissions develop and further refine universal service programs, possible contradictions between universal support policies and competition arise. Policies that foster competition often result in adverse impacts to universal service. This paper examines one of those policy issues. Support of multiple networks, in a universal service environment, is it economically justified? What are the implications to consumers, providers, and states as a whole? Through analysis, these questions are answered and recommendations are provided for the Nebraska Public Service Commission as it faces the dilemma of multiple networks and universal service.

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I. **Background**

In 1996, Congress amended the Federal Communications Act of 1934,[1] (Act), in an effort to develop fair and effective competition for local telephone service. The Act included a mandate that each state support universal service to provide each and every American access to comparable and affordable telephone service.

In 1997, the Nebraska Legislature, pursuant to the federal mandate, passed LB 686 into law, creating the Nebraska Telecommunications Universal Service Fund Act (NUSF Act)[2] and granting authority to, and requiring that, the Nebraska Public Service Commission (Commission) develop a universal service plan for Nebraska.

On January 13, 1999, in response to the federal universal service mandate, the NUSF Act, and the desire to provide all Nebraska citizens with affordable telephone service, the Commission entered its Findings and Conclusions in Docket No. C-1628.[3] The C-1628 Order began the process of reforming the existing system of intrastate universal service support, while at the same time providing for access to affordable telephone service.

The C-1628 Order set forth a transitional universal service mechanism. On March 20, 2001, the Commission concluded it pertinent to continue utilizing the transitional methodology, until such time as a permanent mechanism is developed.[4]

On August 21, 2001, the Commission opened Application No. NUSF-26 to begin the process of examining and

1 47 U.S.C. §§ 151 to 614.

2 Neb. Rev. Stat. §§ 86-1401 to 86-1410.

3 *In the Matter of the Application of the Nebraska Public Service Commission, on its own motion, seeking to conduct an investigation into intrastate access charge reform,* Application No. C-1628, Findings and Conclusion (January 13, 1999) (C-1628 Order).

4 *In the Matter of the Application of the Nebraska Public Service Commission, on its own motion, seeking to conduct an investigation into intrastate access charge reform*, Application No. C-1628/NUSF, Progression Order No. 16 (March 20, 2001).

developing a long-term universal service funding mechanism for Nebraska.[5]

II. Introduction

Within the framework of the proposed long-term universal service funding mechanism, Commission staff proposes the Nebraska Universal Service Fund (Fund) High-Cost Program (Program) support a single network within a given support area.[6]

A policy which supports multiple networks within a given support area, due to the cost involved and the finite resources available to the Fund Program, appears to be outside of the public interest and to foreshadow adverse impacts on Nebraska customers.

The following analysis examines the effect of multiple networks in a universal service environment with limited financial resources. A precursory review of universal service and the use of long-run average total cost in pricing the local loop is performed. The implications of changes in universal service support, due to the support of multiple networks, are then examined. Finally, the impact, on the current telecommunications environment, of providing support to multiple networks is examined and recommendations are put forth.

III. Universal Service and Long Run Cost

Stated elementarily, a firm in any industry experiences costs. In the long run, all costs are considered variable, as changes to all components to production are feasible.

Various costing models and methodologies exist that determine the cost of providing local telephone service.

The Commission utilizes the Benchmark Cost Proxy Model (BCPM), a TELRIC[7] compliant model,[8] in its Nebraska Universal

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5 *In the Matter of the Nebraska Public Service Commission, on its own motion, seeking to establish a long-term universal service funding mechanism*, Application No. NUSF-26, Progression Order No. 4 (August 21, 2001).

6 *In the Matter of the Nebraska Public Service Commission, on its own motion, seeking to establish a long-term universal service funding mechanism*, Application No. NUSF-26, Transcript, Volume I, (June 18, 2003), at 10-11.

7 Total Element Long Run Incremental Cost.

Service Fund Support Allocation Methodology (SAM) to determine a statistical relationship between loop cost and household density.

The BCPM determines the long-run incremental cost of providing the local loop, where the increment is the entirety of facilities attributable to the local loop. Thus, in a particular exchange[9], BCPM results represent the total incremental cost to provide the local loop to that exchange, or the long run marginal cost (LRMC). Stated on a per-line basis, the results represent the long run average total cost[10] (LRATC) of providing the local loop, or, economically speaking, the level at which a provider would set price.[11] The analysis contained herein utilizes the LRATC as a starting point.

IV. Multiple Networks Analyzed in the Short Run

A. Introduction

A brief review of cost in the short run is followed by the development of a reasonable representation of variable cost, by exchange. Once variable cost is determined, comparison with the affordability benchmark utilized in the SAM reveals that, in a support area receiving Fund Program support, the SAM benchmark (SAM-BM) contributes to fixed cost recovery. The implications of changes in universal service support, due to the support of multiple networks, are then examined. The analysis follows.

B. Short Run Cost

In the short run, cost includes fixed inputs to production, such as plant and materials, and variable inputs, such as customer operations and support expenses. Total cost is equal to the sum of total fixed cost and total variable cost.

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8 *See In the Matter of the Commission, on its own motion, to investigate cost studies to establish Qwest Corporation's rates for interconnection, unbundled network elements, transport and termination, and resale,* Application No. C-2516, Findings and Conclusions (April 23, 2002).

9 An exchange, or wire center, is a geographic area over which a local exchange carrier provides service, generally, through the use of a single switch.

10 Recall, in the long run, all costs are considered variable.

11 In this case, LRATC is constant across an exchange.

1. Fixed Cost

Total fixed cost (TFC) is a measure of the cost incurred in the production of goods and services by a firm regardless of the output level. Fixed costs are just that, "fixed." In the short run, a firm is unable to adjust fixed cost to account for changes in the market environment. A change in the level of output does not cause a change in fixed cost.

For example, a Local Exchange Carrier (LEC) generally builds a network to accommodate the majority of the population in an exchange. The addition of a customer to a particular neighborhood may require the installation of a drop from a pedestal to the customer premise. However, for one customer, no additional investment in the feeder and distribution portions of the loop would generally be needed, as there is little, or no, change to investment costs, as the network already exists. Likewise, a decrease in output leaves fixed cost unchanged in the short run.

A utility firm generally experiences relatively greater fixed costs than firms in other industries, as it is typically unusually capital intensive.[12] As an example of the capital intense nature of the provision of local service, in the short run, a LEC is not able to alter the number of switches employed in its network, nor is it able to modify the number of fiber route-miles. Thus, in the telecommunications industry, fixed costs tend to make up a larger portion of total cost than in most other industries.

Average fixed cost (AFC) is a measure of fixed cost per unit of output. As total fixed cost is constant, in the short run, an increase in output allows total cost to be spread across more output and thus reduces AFC. Similarly, a decrease in output induces an increase in AFC.

2. Variable Cost

Total variable cost (TVC) is a measure of the cost incurred in the production of goods and services by a firm, depending on the level of output. For example, a LEC incurs additional costs, such as billing and collection costs, for each additional customer added to the network. These additional costs are

12 Alfred E. Kahn, *The Economics of Regulation Principles and Institutions* (Cambridge, M.A.: The MIT Press, 1988), 35-36.

relative to the increase in output, and therefore, variable in nature.

Average variable cost (AVC) is a measure of variable cost per unit of output.

C. Fixed Versus Variable Cost

In the short run, the majority of the cost related to providing the local loop is fixed. Additionally, as demonstrated in the SAM, a high correlation exists between the cost of the local loop and household density.[13]

It can further be argued that, as the SAM indicated a high correlation between total loop cost and household density, and as the total cost of providing a capital intensive service is comprised of largely fixed cost[14], a high correlation between the fixed cost of providing the local loop and household density also must exist.

Table 1 shows the correlation between LRATC and household density[15] (DNS), as well as the correlation between short run average fixed cost[16] (SRAFC) and DNS. Results show that, just as LRATC and DNS are significantly correlated, so also are SRAFC and DNS.

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13 *In the Matter of the Nebraska Public Service Commission, on its own motion, seeking to establish a long-term universal service funding mechanism*, Application No. NUSF-26, Transcript, Volume III, Exhibit 18, (June 18, 2003) and *In the Matter of the Nebraska Public Service Commission, on its own motion, seeking to establish a long-term universal service funding mechanism*, Application No. NUSF-26, Transcript, Volume I, (June 18, 2003) at 45-47.

14 Based on the Commission’s methodology, BCPM results indicate fixed loop cost comprises, on average, eighty-four percent (84%) of total loop cost. Analysis further estimates, based on BCPM results, approximately eighty-six percent (86%) of the cost associated with connecting users to the public switched network is attributable to the local loop.

15 Household density is a measure of the number of households per square mile in area i.

16 BCPM investment and expense, identified, in the short run, as fixed cost, include; circuit, DLC, copper, fiber, pole, conduit, land, building, and general purpose computers.

Table 1
Cost / Density Correlations[17]

	Low	Medium	High
LRATC/DNS	-69.61%	-69.35%	-60.70%
SRAFC/DNS	-69.45%	-69.10%	-60.51%

Correlation, a measure of the linear association between two variables, here measures the strength of the linear association between the LRATC and DNS, and SRAFC and DNS. Correlation values, by definition, range from –1 to 1, where the extremes indicate perfect covariance between the variables. The results here indicate a strong linear relationship between DNS and both LRATC and SRAFC. Further, the negative signs indicate the tendency for the values of LRATC and SRAFC to be large when DNS is small and conversely, small when DNS is large. These results lend validity to the argument above and indicate DNS can be used to estimate fixed cost, thus further study is justified.

Further developing the above argument, SRAFC is calculated for each exchange, and an econometric model, identical in structure to the SAM and described below, is used to define SRAFC[18] as a function of household density.

D. Expected Short Run Average Fixed Cost

SRAFC, as a function of household density, is developed for each of the BPCM density zones. Regression analysis is used to relate SRAFC to household density. Letting $SRAFC_i$ represent the average fixed loop cost in area i, and DNS_i represent household density in area i, the functional relationship between the two can be described as:

$$SRAFC_i = (\alpha_L e^{-\beta_L * DNS_i}) * (\alpha_M e^{-\beta_M * DNS_i}) * (\alpha_H e^{-\beta_H * DNS_i}) \qquad (1)$$

This functional form allows SRAFC to decrease at a decreasing rate as DNS increases. Taking natural logarithms of each side and including three dummy variables, Equation (1) becomes:

---

17 Low, medium, and high densities are defined as by the SAM. Low; less than or equal to 4.5 households per square mile. Medium; greater than 4.5 and less then or equal to 34 households per square mile. High; greater than 34 households per square mile.

18 See Footnote 16.

$$
\begin{aligned}
\mathrm{Ln}(SRAFC_i) = {} & D_i^{Low}(\gamma_L - \beta_L * DNS_i) \\
& + D_i^{Middle}(\gamma_M - \beta_M * DNS_i) \\
& + D_i^{High}(\gamma_H - \beta_H * DNS_i),
\end{aligned}
\qquad (2)
$$

where $LN(\bullet)$ is the natural log operator and $?_i = Ln(a_i)$ and the dummy variables, D_i^{Low}, D_i^{Middle}, and D_i^{High} take values of one when density falls within certain boundaries and zero otherwise:

$$
D_i^{Low} = \begin{cases} 1 \;\; if \;\; DNS_i = \overline{D^{Low\ Middle}} \\ 0 \qquad Otherwise \end{cases}, \qquad (3A)
$$

$$
D_i^{Middle} = \begin{cases} 1 \;\; if \;\; \overline{D^{Low\ Middle}} < DNS_i = \overline{D^{Middle\ High}} \\ 0 \qquad Otherwise \end{cases}, \qquad (3B)
$$

$$
D_i^{High} = \begin{cases} 1 \;\; if \;\; DNS_i > \overline{D^{Middle\ High}} \\ 0 \qquad Otherwise \end{cases}. \qquad (3C)
$$

Let $\overline{D^{Low\ Middle}}$, equal to 4.5 households per square mile, represent the threshold between the low- and the middle-density areas. Similarly, let $\overline{D^{Middle\ High}}$, equal to 34 households per square mile, represent the threshold between the middle- and the high-density areas.[19]

For relatively sparsely populated areas, the intercept is $?_L$ and the slope is $ß_L$. For medium-density areas, the intercept is $?_M$ and the slope is $ß_M$. For high-density areas, the intercept is $?_H$ and the slope is $ß_H$.

Equation (2) is estimated using linear least squares estimation that minimizes the sum of squared errors associated with the coefficient estimates.[20] Least squares estimation has many statistically desirable attributes and is the typical method used to estimate the coefficients in an equation such as (2) above.

Results from least squares estimation of Equation (2) are:

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19 The optimal values for $\overline{D^{Low\ Middle}}$ and $\overline{D^{Middle\ High}}$ are the values, utilized in the SAM, that maximize the log likelihood function derived from the SAM estimation.

20 For a discussion of least squares estimation, the properties of least squares estimators and potential estimation problems, see William H. Greene, Econometric Analysis, 5th Edition. Upper Saddle River, NJ: Prentice Hall, 2003.

$$\begin{aligned} \mathrm{Ln}(SRAFC_i) = {} & D_i^{Low}(6.3441 - 0.52005 * DNS_i) \\ & + D_i^{Middle}(4.2942 - 0.043885 * DNS_i) \\ & + D_i^{High}(2.7950 - 0.00032467 * DNS_i). \end{aligned} \tag{4}$$

Initial statistical tests indicated the error terms generated from estimating Equation (2) may be heteroscedastic. Heteroscedasticity occurs when the disturbance variances are not constant across observations. When this occurs, the values of the least squares coefficient estimates are unbiased[21], but the variances associated with those coefficient estimates are biased.[22] Statistical methods are used to correct for heteroscedasticity, leaving the parameter estimates in Equation (4) unchanged, but improving the estimated standard errors.

Correcting for heteroscedasticity, all six coefficient estimates in Equation (4) have t-statistics indicating that they are statistically different than zero at the ninety-nine percent (99%) confidence level. The equation has an adjusted R^2 of 0.95, indicating that ninety-five percent (95%) of the variance in the dependent variable, SRAFC, can be explained by the regression equation.

In areas below or equal to 4.5 households per square mile, expected SRAFC as a function of density is:

$$E\{\mathrm{Ln}(SRAFC_i)\} = 6.3441 - 0.52005 * (DNS_i), \tag{5}$$

or, taking the exponential of both sides of Equation (5),

$$E\{SRAFC_i\} = 569.12e^{-0.52005 DNS_i}. \tag{6}$$

In areas with household density above 4.5 but below or equal to 34 households per square mile, expected SRAFC as a function of density is:

$$E\{SRAFC_i\} = 73.27e^{-0.043885 DNS_i}. \tag{7}$$

---

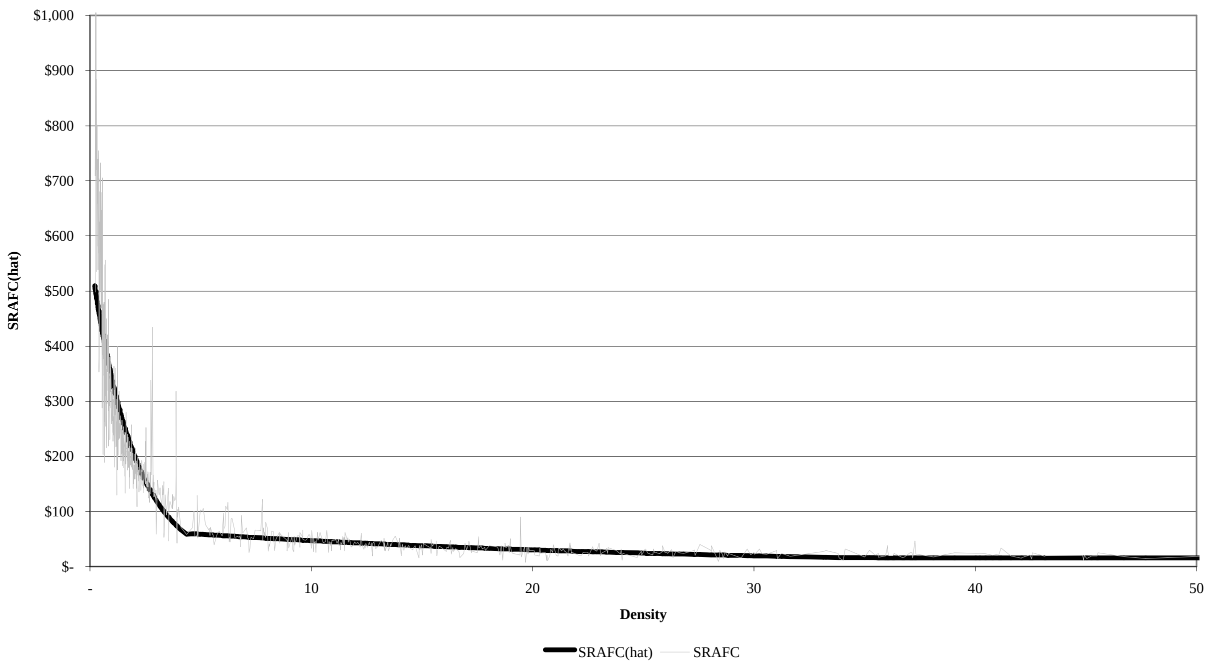
21 Unbiasedness of the coefficient estimates indicates the numbers shown in Equation (4) are the best estimates of the coefficients in the equation.

22 Biased variances indicate standard techniques cannot be used to test for the statistical significance of the coefficient estimates.

In areas where there are greater than 34 households per square mile, the expected SRAFC as a function of density is:

$$E\{SRAFC_i\} = 16.36e^{-0.00032467DNS_i} . \qquad (8)$$

Chart 1
SRAFC Regression Results



With the results, indicating a significant correlation between SRAFC and DNS, coefficients were utilized to develop expected average fixed loop cost for each support area included in the SAM. Expected average fixed loop cost, by support area, was then deducted from the expected total loop cost amounts, previously calculated by the SAM, resulting in a short run average variable cost proxy (SRAVC).

A comparison of the SRAVC measure and the affordability benchmark utilized in the SAM, and the resulting implications, are discussed further below.

E. Revenue Application to Cost

1. SAM-BM and SRAVC

Upon review, in each support area, the affordability benchmark utilized in the SAM, $SAM\text{-}BM_i$, exceeds the short run average variable cost proxy, $SRAVC_i$. The implications of these results are of significance and indicate, in a support area receiving Fund Program support, $SAM\text{-}BM_i$ recovers an amount in excess of $SRAVC_i$, as defined herein, and contributes to fixed cost recovery.

Therefore, short run cost recovery principles indicate each customer contributes to fixed cost recovery. Consequently, a decrease in market share results in a decrease in fixed cost recovery. Additionally, intuitively this then implies all Fund Program support is applied to fixed cost recovery.

2. Marginal Revenue and Marginal Cost

The application of all Fund Program support to fixed cost recovery is taken beyond the intuitive level and further demonstrated with a discussion of marginal revenue and marginal cost.

Marginal revenue (MR) received by a firm is equal to the revenue due to an incremental increase in demand. Here, an increase of one customer increases revenue by $SAM\text{-}BM_i$. Therefore MR_i is equal to $SAM\text{-}BM_i$.

Marginal cost (MC) incurred by a firm is equal to the change in total variable cost with a change in output. Here, an increase of one customer induces a cost, in the short run, equal to $SRAVC_i$. Therefore, MC_i is equal to $SRAVC_i$.[23]

Substitution thus indicates, just as $SAM\text{-}BM_i$ exceeds $SRAVC_i$, MR_i exceeds MC_i, for every support area i. Stated another way, for each additional customer, a LEC receives revenue in excess of the additional cost attributable to said customer.

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23 It should be noted here, by design, SRAVC is constant across an exchange and, in that case, equal to, in the short run, the change in total variable cost with a change in output, or marginal cost (SRMC).

By definition, let $\frac{SRTVC_i}{x_i} = AVC_i$ and $\frac{SRTVC_j}{x_j} = SRAVC_j$, where x represents the quantity of access lines sold. Let $x_j=x_i+1$, representing a one unit incremental increase in the quantity of access lines sold. Then, as SRAVC is constant, $\frac{SRTVC_i}{x_i} = \frac{SRTVC_j}{x_j}$ and, substituting x_i+1 for x_j, $\frac{SRTVC_i}{x_i} = \frac{SRTVC_j}{x_i + 1}$. Solving for $SRTVC_j$;

$$SRTVC_j = \frac{SRTVC_i(x_i + 1)}{x_i} = SRTVC_i + \frac{SRTVC_i}{x_i} = SRTVC_i + SRAVC_i$$

By definition, MC is equal the change in TVC resulting from a one unit change in output, thus $MC_i = \Delta SRTVC = SRTVC_j - SRTVC_i = (SRTVC_i + SRAVC_i) - SRTVC_i$ and $MC_i = \Delta SRTVC = SRAVC_i = SRAVC_j$.

Therefore, in the short run, as MR_i exceeds MC_i, and, by definition, total cost per line exceeds $SAM\text{-}BM_i$, in all support areas receiving Fund Program support, the revenue in excess of MC contributes to fixed cost recovery. Further, Fund Program support does not contribute to variable cost recovery, is necessary to offset fixed cost only, and is applied to fixed cost recovery in totality.

V. <u>Implications of a Multiple Network Environment</u>

The analysis above indicates each incremental loss of market share impacts fixed cost recovery, as $SAM\text{-}BM_i$ exceeds $SRAVC_i$ for every i, and subsequently all Fund Program support is applied to fixed cost recovery. The next section further examines the relationships between market share loss, Fund Program support, and total revenues and the resulting impact.

A. Impact to Fund Program Support

The SAM allocates Fund Program support based on the Program monies available (FPS_{Avl}) and the high-cost nature of a support area, relative to the high-cost nature of the entire state. Formulaically, for those support areas n where expected total cost exceeds the SAM-BM, Fund Program support is calculated as:

$$FPS_n = \left[\frac{\left(E(LC)_n - BM_n\right) q_n}{\sum_{i=1}^{n-1} \left[\left(E(LC)_i - BM_i\right) q_i\right] + \left(E(LC)_n - BM_n\right) q_n} \right] * FPS_{Avl} \qquad (9)$$ [24]

for every support area, *n*, receiving Fund Program support.

For this analysis it is valuable to understand the relationship between FPS and a change in q. Therefore, the partial derivative, with respect to q_n, the number of lines served by the LEC in support area *n*, of FPS_n is calculated. First, let $\bar{T} = \sum_{i=1}^{n-1} \left[\left(E(LC)_i - BM_i\right) q_i\right] > 0$, then:

---

24 FPS_n is the Fund Program support in support area *n*. $E(LC)_n$ is the expected loop cost in support area *n*, as calculated and determined by the SAM. BM_n is the respective SAM-BM in area *n*. FPS_{Avl} is the amount of Fund Program support available for high cost support, and finally, q_n is the number of lines served by the LEC in support area *n*.

$$FPS_n = \left[\frac{(E(LC)_n - BM_n)q_n}{\overline{T} + (E(LC)_n - BM_n)q_n}\right] * FPS_{Avl} \qquad (10)$$

The first order partial derivative of FPS_n, in support area n receiving Fund Program support, with respect to q, is then,

$$\frac{?FPS_n}{?q_n} = FPS_{Avl}\left[\left(\frac{(E(LC)_n - BM_n)}{\overline{T} + (E(LC)_n - BM_n)q_n}\right)\left(1 - \frac{((E(LC)_n - BM_n)q_n)}{\overline{T} + (E(LC)_n - BM_n)q_n}\right)\right]$$ (11)[25]

By definition, $(E(LC)_n - BM_n) > 0$ for every exchange n receiving Fund Program support. Thus, the first term is greater than zero. By definition, $0 \le \left[\frac{((E(LC)_n - BM_n)q_n)}{\overline{T} + (E(LC)_n - BM_n)q_n}\right] \le 1$ for every i. The second term is then also greater than zero, as one minus x, where x<1, is greater than zero.[26] Thus, the product of the terms are greater than zero and, for every support area n,

$$\frac{?FPS_n}{?q_n} > 0. \qquad (12)$$

The positive derivative indicates an incremental change to q will result in a change to FPS in the same "direction".

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25 The full derivation of Equation (10) is displayed here;

$$\frac{\partial}{\partial q_n}(FPS_n) = \frac{\partial}{\partial q_n}\left(\left[\frac{(E(LC)_n - BM_n)q_n}{\overline{T} + (E(LC)_n - BM_n)q_n}\right] * FPS_{Avl}\right)$$

Using the product rule of differentiation;

$$\frac{?FPS_n}{?q_n} = FPS_{Avl}\left[[(E(LC)_n - BM_n)q_n] * \frac{\partial}{\partial q_n}\left(\frac{1}{\overline{T} + (E(LC)_n - BM_n)q_n}\right) + \frac{1}{\overline{T} + (E(LC)_n - BM_n)q_n} * \frac{\partial}{\partial q_n}((E(LC)_n - BM_n)q_n)\right]$$

Several simplification steps are performed;

$$\frac{?FPS_n}{?q_n} = FPS_{Avl}\left[(E(LC)_n - BM_n)q_n * \left(\frac{(-1)\frac{\partial}{\partial q_n}[(E(LC)_n - BM_n)q_n]}{[\overline{T} + (E(LC)_n - BM_n)q_n]^2}\right) + \frac{1}{\overline{T} + (E(LC)_n - BM_n)q_n} * ((E(LC)_n - BM_n))\right]$$

$$\frac{?FPS_n}{?q_n} = FPS_{Avl}\left[\frac{(-1)((E(LC)_n - BM_n)q_n)(E(LC)_n - BM_n)}{[\overline{T} + (E(LC)_n - BM_n)q_n]^2} + \frac{(E(LC)_n - BM_n)}{\overline{T} + (E(LC)_n - BM_n)q_n}\right]$$

$$\frac{?FPS_n}{?q_n} = FPS_{Avl}\left[\frac{(E(LC)_n - BM_n)}{\overline{T} + (E(LC)_n - BM_n)q_n} - \frac{((E(LC)_n - BM_n)q_n)(E(LC)_n - BM_n)}{[\overline{T} + (E(LC)_n - BM_n)q_n]^2}\right]$$

A final simplification and rearrangement is performed to arrive at Equation (11).

$$\frac{?FPS_n}{?q_n} = FPS_{Avl}\left[\left(\frac{(E(LC)_n - BM_n)}{\overline{T} + (E(LC)_n - BM_n)q_n}\right)\left(1 - \frac{((E(LC)_n - BM_n)q_n)}{\overline{T} + (E(LC)_n - BM_n)q_n}\right)\right]$$

26 For the purposes here, the case of $\left[\frac{((E(LC)_n - BM_n)q_n)}{\overline{T} + (E(LC)_n - BM_n)q_n}\right]=1$ is discarded as nonsensical, eliminating the possibility of the second term being equal to zero.

Stated another way, the positive partial derivative indicates a decrease in lines served by the LEC in support area *n*, results in a decrease in LEC Fund Program support in support area *n*.

These results are telling and imply, should the Commission support multiple networks, market share loss experienced by the primary network will result in a decrease in Fund Program support.

The positive derivative does not imply it is the general opinion of the Commission that Fund Program support should decrease as q decreases, nor increase as q increases. Rather the result is a descriptive tool to be used to further explicate the mechanics of the SAM.

B. Elasticity of Support

The elasticity, calculated here, provides a quantitative measure of the sensitivity of Fund Program support, relative to a change in q. Stated another way, the elasticity is an analytical device with which to determine the percentage change in Fund Program support induced by a one percent change in q.

Elasticity of Fund Program support with respect to q is calculated as;

$$\varepsilon_{FPS_n q_n} = \left(\frac{\partial FPS_n}{\partial q_n}\right)\left(\frac{q_n}{FPS_n}\right). \qquad (13)$$

Substituting the results of $\frac{?FPS_i}{?q_i}$ from above and solving;

$$\varepsilon_{FPS_n q_n} = 1 - \frac{\left(E(LC)_n - BM_n\right)q_n}{\bar{T} + \left(E(LC)_n - BM_n\right)q_n} = \frac{\bar{T}}{\bar{T} + \left(E(LC)_n - BM_n\right)q_n} \qquad (14)^{27}$$

---

27 The full derivation of Equation (13) is displayed here;

$$\varepsilon_{FPS_n q_n} = \left(\frac{\partial FPS_n}{\partial q_n}\right)\left(\frac{q_n}{FPS_n}\right)$$

$$\varepsilon_{FPS_n q_n} = FPS_{Avl}\left[\left(\frac{\left(E(LC)_n - BM_n\right)}{\bar{T} + \left(E(LC)_n - BM_n\right)q_n}\right)\left(1 - \frac{\left(\left(E(LC)_n - BM_n\right)q_n\right)}{\bar{T} + \left(E(LC)_n - BM_n\right)q_n}\right)\right]\left[\frac{\bar{T} + \left(E(LC)_n - BM_n\right)q_n}{\left(E(LC)_n - BM_n\right)q_n}\right]\left(\frac{q_n}{FPS_{Avl}}\right)$$

Cancellation of terms and a final simplification is performed to arrive at Equation (14).

$$\varepsilon_{FPS_n q_n} = 1 - \frac{\left(E(LC)_n - BM_n\right)q_n}{\bar{T} + \left(E(LC)_n - BM_n\right)q_n} = \frac{\bar{T}}{\bar{T} + \left(E(LC)_n - BM_n\right)q_n}$$

These results indicate the elasticity of Fund Program support, with respect to *q*, in support area *n* is less than or equal to one at all times[28], i.e. the percentage change in Fund Program Support is less than or equal to the percentage change in q. Thus, a one percent (1%) decrease in q will elicit a decrease in Fund Program support of less than, or equal to, one percent (1%).

However the results further indicate, for high-cost support areas with the smallest impact relative to the high-cost nature of the entire state, a change in q will cause the greatest downward effect to said support area's Fund Program support.[29] Thus, a high-cost support area, where expected loop cost significantly exceeds the benchmark, but is sparsely populated, will be more affected by market share loss.

C. Impact to Total Revenue

Taking the analysis one step further and examining total revenue (TR), further ominous results are revealed. In support areas receiving Fund Program support, total revenue is the sum of the Program support amount and amounts paid by customers.

$$TR_i = FPS_i + BM_i(q_i) \qquad (15)$$

The results of taking the partial derivative of Equation (15), with respect to *q*, is listed below.

$$\frac{\partial TR_i}{\partial q_i} = \frac{\partial}{\partial q_i}\left(FPS_i\right) + BM_i > 0 \qquad (16)^{30}$$

By Fund Program design, an increase in q_i results in no immediate change to Fund Program support. However, as $\frac{\partial TR_i}{\partial q_i} > 0$ indicates, a decrease in q_i results in a decrease in total revenues. Thus, in those support areas receiving Fund Program

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28 Recall, by definition, $0 \le \left[\frac{((E(LC)_n - BM_n)q_n)}{\overline{T} + (E(LC)_n - BM_n)q_n}\right] \le 1$ for every i.

29 $\lim_{[(E(LC)_n)-BM_n]q_n \to 0}\left[\varepsilon_{FPS_n q_n}\right] = \lim_{[(E(LC)_n)-BM_n]q_n \to 0}\left[1 - \frac{(E(LC)_n - BM_n)q_n}{\overline{T} + (E(LC)_n - BM_n)q_n}\right] = 1.$

30 Recall $\frac{\partial}{\partial q_i}\left(FPS_i\right) > 0$, for every i.

support, a loss of market share results in further deterioration of total revenues.

VI. Conclusions

A. Summary

The Commission staff proposes the Fund Program support a single network within a given support area. The above analysis demonstrates, diversion from such a policy predicates adverse effects on Nebraska customers.

This analysis demonstrates, in a support area receiving Fund Program support; the SAM-BM exceeds SRAVC and therefore contributes to fixed cost recovery, all Fund Program support is applied to fixed cost recovery, market share loss results in a decrease in Fund Program support and total revenue, and the affects of said market share loss can be most devastating in sparsely populated high-cost support areas.

In the short run, in a multiple provider scenario, declining market share results in the loss of the SAM-BM's contribution to fixed cost, as well as the loss of Fund Program support, ultimately reducing total revenue. Consequently, in the long run, a provider losing market share will fail to recover a portion of fixed cost, as defined herein.[31,32]

Economic theory dictates, a provider that does not recover its fixed cost, in the long run, has three alternatives; increase retail rates, increase the amount of Fund Program support received, or exit the market.

1. Increase Retail Rates

An increase to retail rates would allow a provider to account for the recovery of costs over a smaller base of customers.

However, in the support areas receiving Fund Program support, the level of the LRATC already exceeds the respective SAM-BM. Therefore, absent Commission action altering affordability standards and assigning a benchmark in excess of

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31 In the long run, fixed cost is a part of LRATC.

32 The statements made here are not a Commission endorsement of total cost recovery.

that which is employed today, all rate increases would result in additional Fund Program liabilities.

Further, should Commission action increase the benchmark, it is unclear whether such action would be in violation of the public interest and reasonable and comparable standards.[33]

The following is explored for illustrative purposes. Results of the SAM indicate the highest-cost support area is allocated approximately 1.84 percent of the Program monies available. Utilizing the results above, said support area's elasticity is 0.9816, or a 0.9816 percent decrease in Fund Program Support for every one percent decrease in q. Thus, if Program monies available are $65 million, and number of access lines in said support area is 762, a $1.12 increase per line is necessary to offset each percent decrease in market share.[34]

2. Increase Fund Program Support

Additional Fund Program support amounts would also allow a provider to account for the recovery of fixed costs over the long run.

However, an increase in Fund Program support would necessitate an increase in the Fund Program Surcharge (SRCHRG), currently 6.95 percent, and ultimately passed on to the users of intrastate telecommunications service in Nebraska.

In general, a one percent decrease in market share would necessitate an increase in the Surcharge equal to the product of the elasticity of the support area experiencing the market share loss and the relative high-cost nature of the support area.[35]

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33 Neb. Rev. Stat. § 86-323 and 47 U.S.C. § 254(b)(1).

34 Recall, the access lines per household ratio utilized by the SAM is 1.15, then $\frac{(65000000 * 0.0184) * \left(\frac{1 - 0.0184}{100}\right)}{12 * 762 * 1.15} = \$1.12$ represents a per line increase.

35 Generally, using the increase portion of the calculation in Footnote 34, setting

$$\frac{SRCHRG_{t=0}}{FPS_{Avl}} = \frac{SRCHRG_{t=1}}{FPS_{Avl}\left(1 + \frac{(E(LC)_n - BM_n)q_n}{\overline{T} + (E(LC)_n - BM_n)q_n} * \varepsilon_{FPS_n q_n}\right)}$$

Solving for $SRCHRG_{t=1}$,

$$SRCHRG_{t=1} = SRCHRG_{t=0} * \left(1 + \frac{(E(LC)_n - BM_n)q_n}{\overline{T} + (E(LC)_n - BM_n)q_n} * \varepsilon_{FPS_n q_n}\right)$$

3. Exit Market

The final option available to a provider is exit the market. Terminate all local service in the particular high-cost support area. This option, while totally antithetical to the core objectives and goals of universal service, would have an extremely detrimental affect on the customers residing in the high-cost support area, and ultimately the entire state.

B. Recommendations

In an environment with limited financial resources and multiple networks, there may be significant negative impacts to customers and universal service. A policy which supports multiple networks within a given support area, due to the cost involved, is not in the public interest and adversely impacts Nebraska customers.

Therefore, based on the analysis above, we believe it unsustainable to support multiple networks in a universal service environment with limited financial resources.